



Horizon 2020
European Union Funding
for Research & Innovation



H2020 MaRINET-2 Project

Training course on

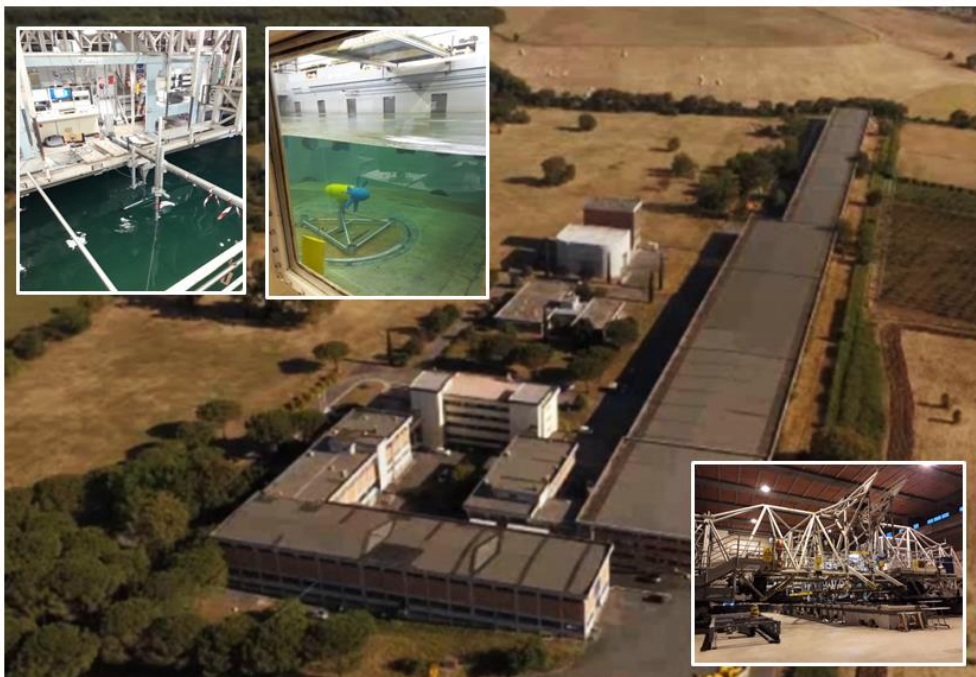
***“Model scale testing of tidal energy converters
in towing tanks and depressurised channels”***

Organized by CNR-INM, The Marine Engineering Institute

Italian National Research Council

(former INSEAN)

Rome, Italy, February 25 – 28, 2019



Course program summary:

<i>Day</i>	<i>Activity</i>
Monday 25	Introduction to MaRINET-2 & of Training Course program Presentation of CNR-INM Towing tank and water flume testing environments Scaled models and testing protocols Measurement equipment and data acquisition
Tuesday 26	Performance measurements: towing tank Vs. flume Flume tank testing session: turbine performance Cavitation Visit to cavitation tunnel: examples of cavitation tests
Wednesday 27	Velocimetry techniques Wave current interaction Towing tank testing session: wave/current interaction study
Thursday 28	Integrating experimental work with computational modelling Tidal turbine technology development: a case study Application to MaRINET-2 TNA calls and wrap-up

Venue:

CNR-INM, The Marine Engineering Institute, National Research Council
(former INSEAN)
Via di Vallerano, 139 – 00128 Rome, Italy

Local Contact:

Francesco Salvatore:

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Tel.: +39 06 5029-9313

Course outline:

Monday 25

- 09:30 – 10:00 **Welcome coffee and get together with speakers**
- Session 1.1 **Introduction to MaRINET-2 courses & to CNR-INM**
Auditorium talk – Speakers: F. Salvatore, F. Di Felice
- The MaRINET-2 Project and TNA program
 - MaRINET-2 Training Courses (TC): presentation of the Training Course program on tidal turbine testing
 - Presentation of CNR-INM: profile, activities, infrastructures
 - Discussion, Q&A
- Session 1.2 **Towing tank and water flume testing environments**
Auditorium talk – Speakers: F. Di Felice
- Description of facilities for testing turbines at laboratory scale
 - Modelling tidal site conditions in tanks and flumes
 -
- 13:00 – 14:00 *Lunch break*
- Session 1.3 **Scaled models and testing protocols**
Auditorium talk – Speaker: I. Santic
- Scaling criteria: Buckingham Pi Theorem, scaling laws
 - Device classification: Horizontal/cross-flow/kyte/...
 - PTO modelling
 - Model device: requirements for successful tests
 - Test procedures: ITTC, Equimar, MaRINET-x, IEC
- Session 1.4 **Measurement equipment and data acquisition**
Auditorium talk – Speaker: I. Santic
- Basic concept of measurement
 - Resource: flow speed, turbulence, waves
 - Device performance: RPM and global loads, velocimetry, radiated noise
 - Data acquisition
 - Special set-up: Single-blade loads sensors, pointwise pressure on blade, blade deflections
- 16:30 – 17:00 **Adjourn**

Tuesday 26

- 9:30 Welcome
- Session 2.1 **Performance measurements: towing tank Vs. flume**
Auditorium talk – Speaker: F. Di Felice
- Set-up in a towing tank: supported, floating devices
 - Set-up in a flume: supported, bottom fixed devices
 - Flume test: presentation of test exercise
- Session 2.2 **Flume tank testing session: turbine performance**
Access to facility – Speaker: F. Di Felice
- Experimental set-up: test matrix definition
 - Trials in the depressurised circulating water channel
 - Analysis: data acquisition and post processing
- 13:00 – 14:00 *Lunch break*
- Session 2.3 **Cavitation**
Auditorium talk – Speaker: F. Alves Pereira
- The physics of multi-phase flows
 - Inception and cavitation on lifting surfaces and turbines
 - Testing turbine cavitation in depressurized flumes
- Session 2.4 **Visit to cavitation tunnel facility**
Access to Facility – Speaker: F. Alves Pereira
- Visit to the cavitation tunnel facility
 - Examples of model rotor tests in depressurised conditions
- 16:30 – 17:00 **Adjourn**

Wednesday 27

- 9:30 Welcome
- Session 3.1 **Advanced velocimetry techniques**
Auditorium talk – Speaker: G. Aloisio, S. Grizzi, M. Falchi
- Laser-Doppler Velocimetry (LDV)
 - Particle-Image Velocimetry (PIV, S-PIV)
 - Set-up examples for LDV and PIV in tow and flume tanks
 - Velocimetry studies: Laboratory vs. tidal site
- Session 3.2 **Waves and wave/current interaction**
Auditorium talk – Speakers: L. Fabbri, G. Colicchio
- Wave theory: regular waves
 - Wave theory: irregular waves and sea spectra
 - Wave-current interaction
 - Effects of wave motions on turbine performance
- Session 3.3 **Towing tank testing session: wave/current interaction study**
Access to facility – Speaker: L. Fabbri, M. Falchi, G. Colicchio
- Experimental set-up: test matrix definition
 - Trials in the wave tank
 - Analysis: wave propagation, test results compared with theoretical model/numerical data
- 13:00 – 14:00 *Lunch break*
- Session 3.4 **Towing tank testing session: wave/current interaction study**
Access to facility – Speaker: L. Fabbri, M. Falchi, G. Colicchio
- Session 3.3 continued
- 16:30 – 17:00 **Adjourn**

Thursday 28

9:30 Welcome

- Session 4.1 **Integrating experimental work with computational modelling**
Auditorium talk – Speaker: G. Dubbioso, D. Calcagni, F. Salvatore
- Variable fidelity models: BEM, BIEM, Navier-Stokes and hybrid models
 - CFD models to support design of experimental campaign and set-up preparation
 - Planning experiments and elaboration of measured data to build databases for validation of CFD models

- Session 4.2 **Tidal turbine technology development: a case study**
Auditorium talk – Speaker: t.b.c.
- A guest speaker from Industry will present developer's viewpoint on the importance of lab-scale tests for the development of devices

13:00 – 14:00 *Lunch break*

- Session 4.3 **Course conclusion**
Auditorium talk – Speakers: F. Di Felice, F. Salvatore
- how to develop device TRL through model tests
 - how to successfully apply to MaRINET-2 TNA calls
 - Wrap-up discussion and audience feedback

16:00 **End of Course**

Accommodation and getting to CNR-INM

Rome is a top destination for tourism and business travels and has a rich offer for accommodation, with more than 1000 hotels and hundreds of guest houses, B&B and other all-budget solutions. Assuming that visitors will use popular accommodation search engines available on the web, here city areas with easy connection to CNR-INM and to the city transport network are indicated. A number of 3-4 stars hotels is also given for completeness (see Map no.3 and list).

CNR-INM is located in the South edge of Rome, in **Via di Vallerano, 139**. Using public transport, **bus no. 071** connects Via di Vallerano with Subway Stop **EUR FERMI (Metro Line B)**, see maps no. 1 and 2. Then, it can be convenient to look for accommodation in the **EUR district**, or in city areas close to Metro Line B stations between EUR and **TERMINI**. Termini is the city central railway station and main hub for public transports: Metro lines A, B, city buses, train and bus connections to city airports: Fiumicino/Leonardo da Vinci (FCO) and Ciampino/Pastine (CIA).

City transports

Public transports company is **ATAC**: <https://www.atac.roma.it/index.asp?lingua=ENG>
Basic ticket costs 1,50 Euro and is valid for 100 minutes on all transports, any number of changes (except for Metro, where it is valid for 1 ride only). Other options include 24/48/72 hours, weekly Tickets.
An application for smartphones is available for easy ticketing.
See details on: <https://www.atac.roma.it/page.asp?p=229&i=14>

An interactive Map for city Metro lines can be found on:
<http://viaggiakon.atac.roma.it/index.html?language=eng>

Airport transports

A single website for the two city airports: <http://www.adr.it>
Fiumicino (FCO) is connected to the city by train, bus and taxi. Train is the most effective connection.
Two options:

- Leonardo Express, non-stop service to/from Rome Termini railway station leaving every 15 minutes* with a journey time of 32 minutes. One-way ticket costs 14,00 Euro.
- Regional FL1 trains to/from several stations in Rome, including Rome Tiburtina railway station, with departures every 15 minutes on weekdays and every 30 minutes on weekends and holidays. One-way ticket costs 8,00 Euro. Trains can be crowded during rush hours.

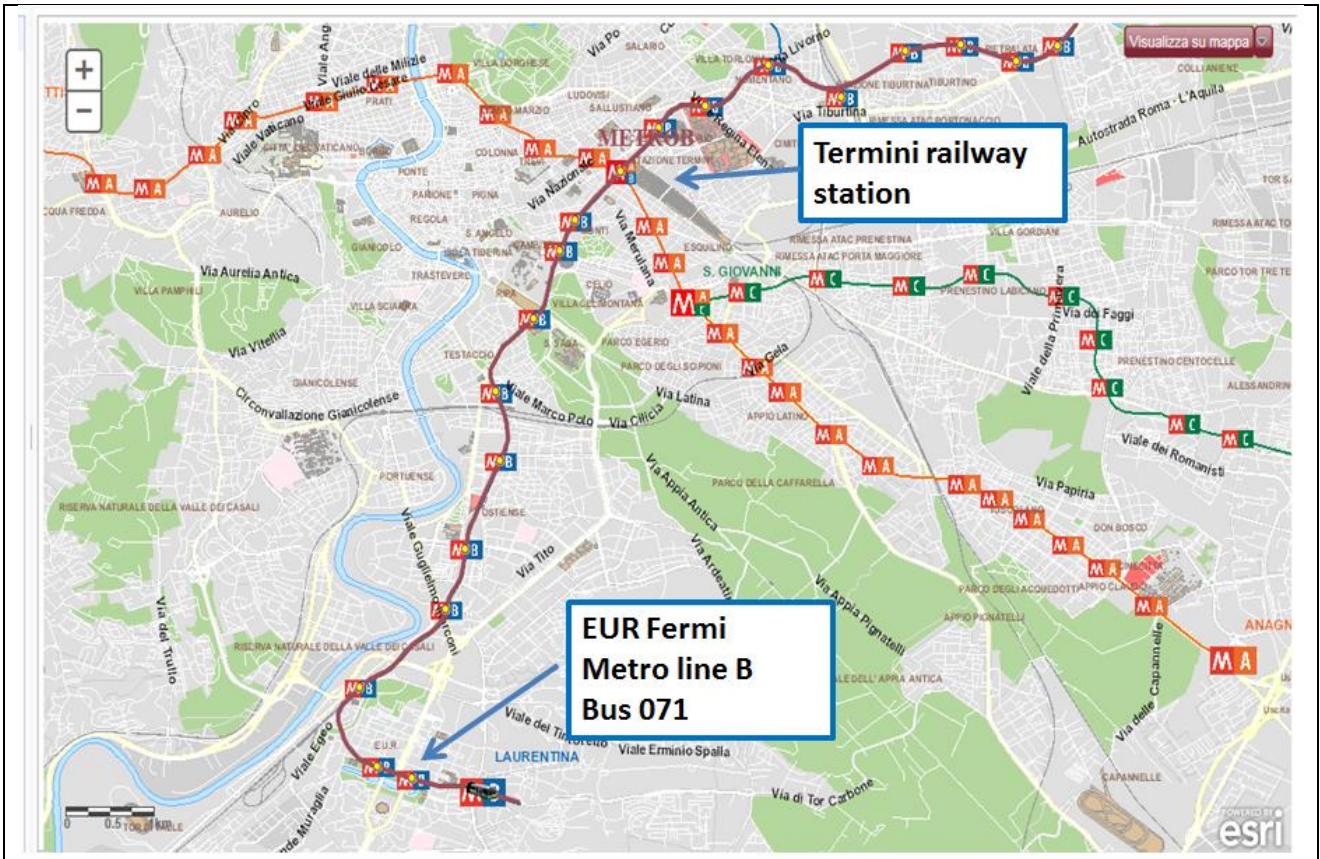
Please check timetable for trains before 6am and after 11pm. More details and timetables on:
<http://www.adr.it/web/aeroporti-di-roma-en-/pax-fco-to-and-from>
Or visiting **TRENITALIA** railway company website: <https://www.trenitalia.com/>

The easiest way to connect Ciampino airport (CIA) and Rome is by bus or taxi. See details on:
<http://www.adr.it/web/aeroporti-di-roma-en-/pax-cia-bus>

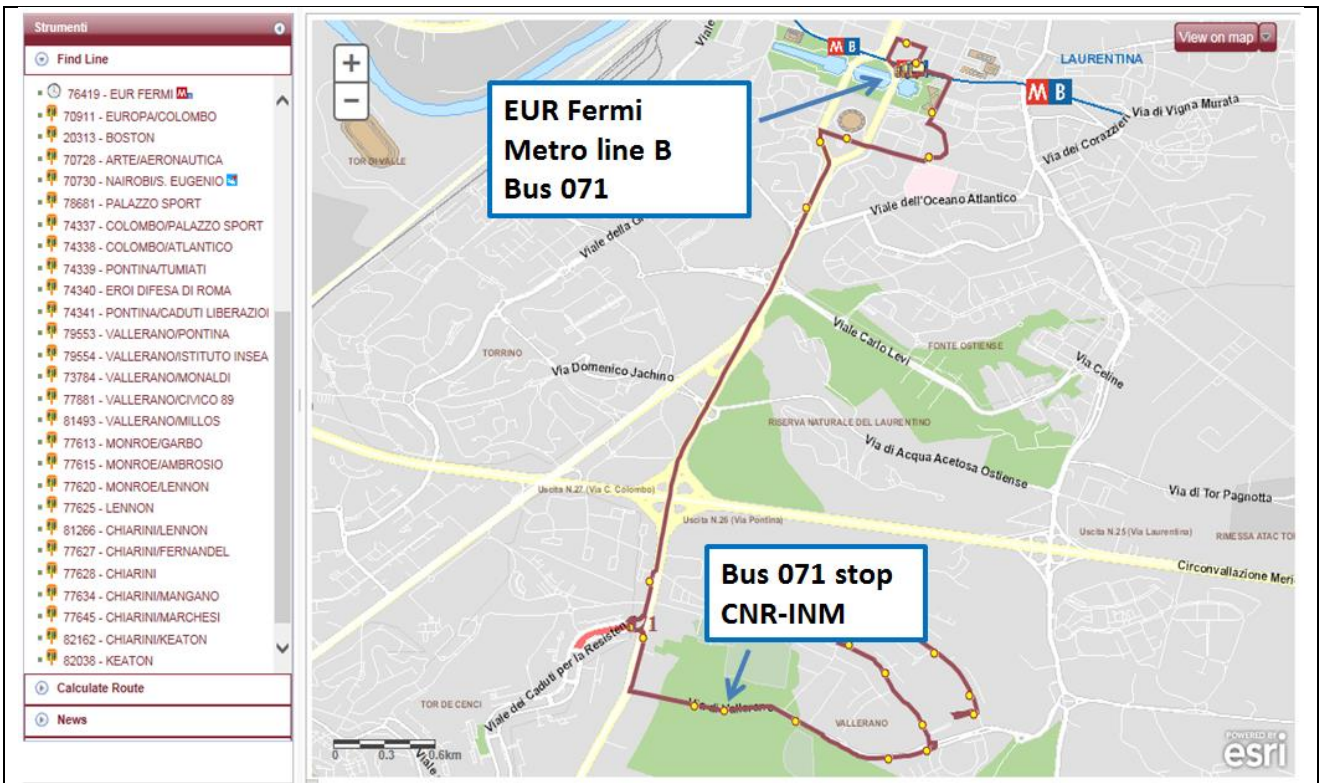
Getting to Rome by train

Long distance trains stop in **TERMINI** station (central station). This is the main hub for public transports, including Metro lines A, B, city buses, train and bus connections to airports.

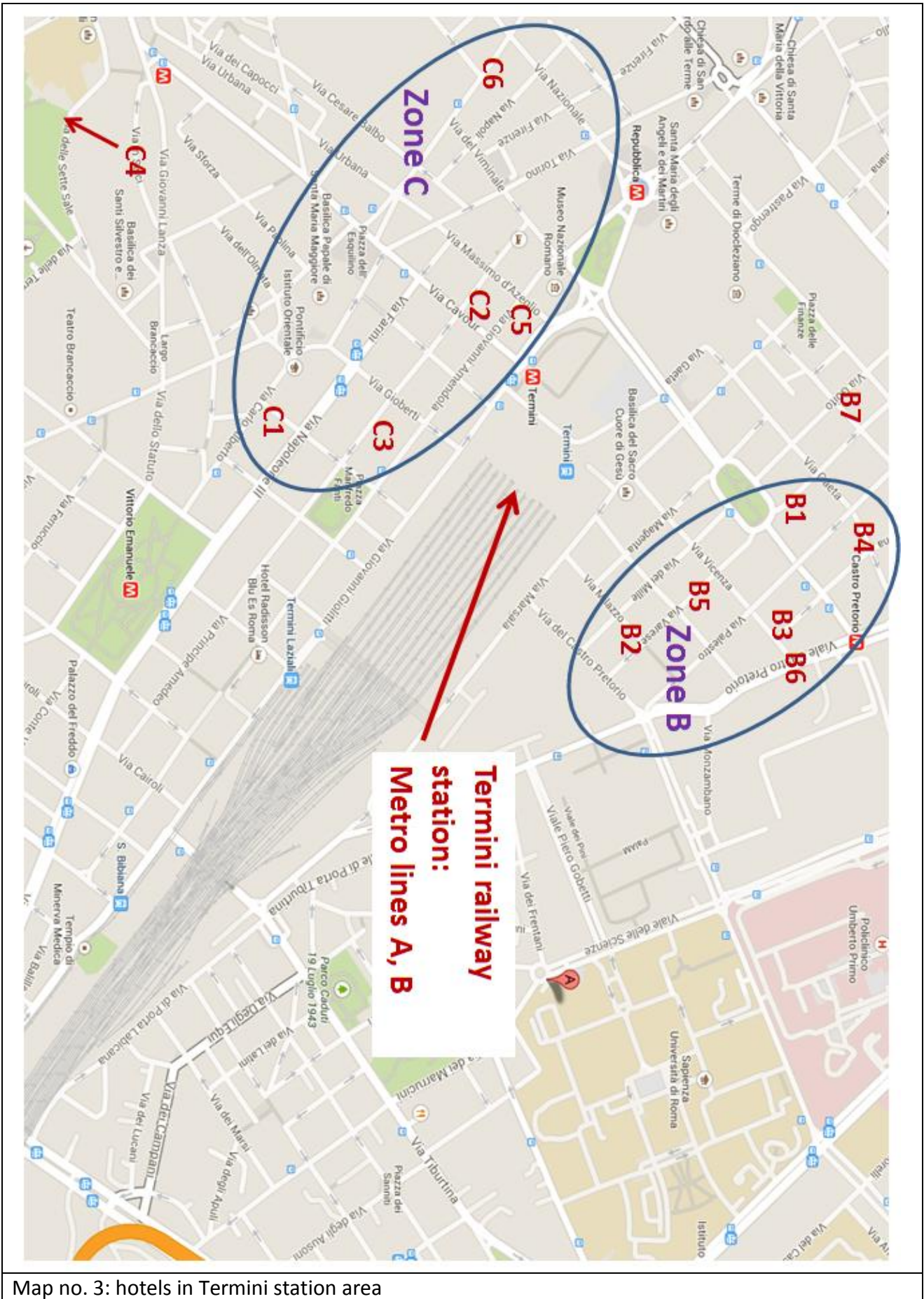
A limited number of trains stop in **TIBURTINA** station and **OSTIENSE** station. Both stations are served by metro Line B.



Map no.1 : Connection Termini/EUR Fermi via metro line B



Map no.2 : Connection EUR Fermi/CNR-INM via bus no. 071



Map no. 3: hotels in Termini station area

B1 - Hotel Alpi (**)** <http://www.hotelalpi.com/>

Via Castelfidardo, 84 - 00185 Rome

Tel. +39 06 444 1235

Email: info@hotelalpi.com

B3 - Hotel Best Western Villafranca (**)** www.villafrancaroma.it

Via Villafranca, 9 - 00185 Rome

Tel. +39 06 444 0364

Email: info@hotelvillafrancaroma.it

B4 - Hotel Best Western Art Deco' (**)** www.hotelartdecorome.com

Via Palestro, 19 - 00185 Rome

Tel. +39 06 4457588

Email: info@hotelartdecorome.com

B5 - Hotel Astoria Garden (*)** www.hotelastoriagarden.it

Via Vittorio Bachelet, 8 - 00185 Rome

Tel. +39 06 446 9908

Email: hotelastoriagarden@tiscalinet.it

B6 - Hotel Best Western Canada (*)** www.hotelcanadaroma.com/

Via Vicenza, 58 - 00185 Rome

Tel. +39 06 4457770

Email: info@hotelcanadaroma.com

C2 - HOTEL ATLANTICO (**)** www.romehotelatlantico.it

Via Cavour, 23 (near to Metro Station "Termini")

tel. +39 06 485951 fax +39 06 4827492

Email: atlantico@bettojahotels.it

C3 - HOTEL DIANA (**)** www.hoteldianaroma.com

Via Principe Amedeo, 4 (near to Metro Station "Termini")

Tel. +39 06 478681

Email: info@hoteldianaroma.com

C4 - HOTEL MERCURE DELTA COLOSSEO (**)**

<http://www.accorhotels.com/gb/hotel-2909-mercure-roma-centro-colosseo/index.shtml>

Via Labicana, 144 (near to Metro Station "Colosseo")

tel : +39 06 770021

Email : H2909@accor.com

C5 - HOTEL NORD (*)** www.hotelnordnuovaroma.it

Via G. Amendola, 3 (near to Metro Station "Termini")

tel. +39 06 4885441 fax +39 06 4817163

Email: info@hotelnordnuovaroma.it

C6 - HOTEL ITALIA ()** www.hotelitaliaroma.it

Via Venezia 18 (near to Metro Station "Termini" and "Cavour")

Tel. +39 06 4828355

Email: info@hotelitaliaroma.it